1
DESIGN

DESIGN RECOMMENDATIONS INDEX

2019
MODEL YEAR

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DESIGN RECOMMENDATIONS
FUEL SYSTEM

FUEL SYSTEM

WARNING:
Before opening the fuel system, relieve fuel pressure by following the instructions in the *Ford Truck Shop Manual* for the appropriate model and model year. The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. When welding near fuel system components, all metallic components should be adequately shielded and protected from heat or weld splatter. All non-metallic components should be removed. Removal or re-installation of any Ford fuel system component should be performed to the specifications and instructions found in the *Ford Truck Shop Manual* for the appropriate model and model year.

INFORMATION

The following recommendations are intended to assist in the design and completion of the fuel system capable of meeting the requirements of F/CMVSS 301. These recommendations are based on testing and analysis performed by Ford Motor Company.

Since completed vehicles may take many forms, this list of recommendations cannot cover all possibilities. Strict adherence to these suggestions will not ensure that the completed vehicle will comply with F/CMVSS 301. The responsibility for determining compliance to F/CMVSS 301 regulations is that of the final stage manufacturer. Accordingly, Ford Motor Company makes no representations as to the appropriateness of any particular recommendation in its specific application to a particular design or act of intermediate or final stage manufacture.

To verify compliance with F/CMVSS 301, testing of representative vehicles to applicable F/CMVSS 301 procedures may be necessary. Questions regarding compliance with F/CMVSS regulations should be directed to your legal counsel, the National Highway Traffic Safety Administration, or Transport Canada.

Any alteration or modification of a vehicle's fuel or evaporative system may affect the vehicle's compliance with applicable federal and state emission laws, including on-board diagnostics (OBDII) and evaporative emissions requirements, and may also effect vehicle performance (driveability, idle quality, etc.). Vehicle modifiers are responsible for ensuring that a vehicle, as modified, complies with all applicable emissions regulations and for obtaining any necessary federal or state approval or certification relating to vehicle modification or sale of add-on or auxiliary parts.

A. NEW FUEL TANKS

1. The fuel tank should be designed with as few openings and connections as possible. Openings and connections generally should be located on the upper surface of the fuel tank.
2. Fuel tanks should be fitted with an evaporation control valve having the means to close if the vehicle is rotated about a longitudinal axis pursuant to F/CMVSS 301.
3. The tank should be of simple configuration minimizing sharp surface transitions and protrusions which may be required for attachment or function.
4. The tank should be strong enough to with stand instantaneous internal pressure imposed in the event of crash situations.
5. Hoses connected to the tank should be sufficiently flexible to permit small movements of the tank relative to fixed mounting surfaces, without rupture or disconnection of such hoses in the event of crash situations.
6. Emission regulations may require an OBDII fuel tank pressure sensor for the evaporative system. Any new fuel tank must be tested and comply with all emission regulations, including evaporative emissions.
7. Package new tank away from heat sources such as exhaust.

B. NEW FUEL TANK RETENTION SYSTEMS

1. The retention system should attach the fuel tank to the frame, between the frame rails, and below the body of the vehicle with sufficient clearance for normal body to frame movement under loaded conditions.
2. A retention system should restrict fuel tank movement in all possible directions to prevent contact or rupture with rigid or sharp objects, and the disconnection of fuel system tubes and hoses under crash conditions. Retention straps should avoid sharp edges and tank supports should be designed with fuel tank compatible surfaces and edges to the fuel tank.
3. System fasteners and attachments should be designed to retain the tank during deflections incurred in crash situations.

C. FUEL FILL SYSTEM

1. Fill system should be sufficiently flexible to prevent possible rupture or disconnection resulting from movement of the fuel tank relative to frame during crash situations. Use the original pickup truck filler if the fill location is similar to the original pickup truck location.
2. Any appliance or hardware attachments to the body in the area of a fuel system component should be designed, positioned, and secured so as not to impact any fuel system component during crash situations.
3. The fuel filler opening area of the body should provide adequate sealing from the vehicle interior because holes or cracks in this area may allow fuel vapors to enter the vehicle interior. Openings should be sealed with a product which is fuel resistant. See Figure A on this page.
4. The metal outer end of the fuel fill neck tube provided by Ford must be properly grounded to the chassis to dissipate any electrostatic charge that may be produced and so reduce the possibility of a spark during fueling. A fill neck support made of metal would provide a ground path if directly mounted on the chassis. If the filler neck support is made of plastic or other non-metallic material, a ground strap or wire must connect the metal end of the fuel filler neck and a metal chassis component.
5. Fill openings should be recessed, and caps, when installed, should be inside the normal body plane.
6. Whenever possible, the fill system should pass under the body rather than through it. Where passing through floors and sides, the fill system should be shielded and have adequate clearance to surrounding structure. Fuel Filler and Vent Hoses should maintain a minimum of one inch clearance to body and surrounding chassis components, except where the hoses and protective sleeve material pass through the designed frame opening.
7. Be sure that the fuel tank filler cap is the correct Ford designated part. Provide adequate hand clearance for cap installation and correct sealing of the cap to filler pipe.
8. The recommended horizontal and vertical locations for the fuel tank filler pipe are shown in the E-Series and Super Duty F-Series sections of this book.

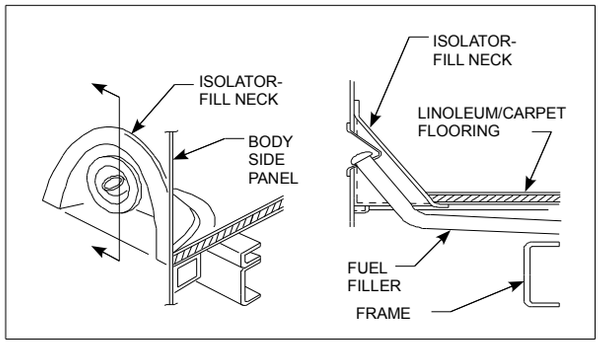

FIGURE A – BODY MOUNTED FUEL FILLER OPENINGS

VEHICLE	ENGINE	FUEL TANK	FUEL FILL KIT P/N
F-Super Duty			
Chassis Cab	Diesel	Midship	HC3Z-9B149-A
		Aft of axle	HC3Z-9B149-C
	Gas	Midship	HC3Z-9B149-B
		Aft of axle	HC3Z-9B149-D
Wide Frame Pickup	Diesel	Box delete	HC3Z-9B149-E
		Box removed	9C3Z-9B149-B
	Gas	Box delete	HC3Z-9B149-F
		Box removed	8C3Z-9B149-J
E-Series Cutaway			
E350/450/ School Bus	FFV	Aft of axle	9C2Z-9B149-A
	Gas		9C2Z-9B149-C

Other parts that can be ordered/purchased separately:

PART DESCRIPTION	SERVICE P/N
Support (unskirted body)	E0TZ-9040-A
Label – Unleaded Fuel	D702-9A095-A
Label – Diesel Fuel	E432-9A095-A

(Cont'd next page)

C. FUEL FILL SYSTEM (CONT'D)

9. When installing accessories or equipment, avoid exposure of fuel and vapor hoses to surfaces with sharp edges (see Figure B on this page) or high temperature surfaces (near hot exhaust or coolant). Also avoid installations which result in the exposure of these lines to road debris or undercoating.
10. Install or route fuel tank filler hoses and filler vent hoses as follows:
    a) Avoid sags below the horizontal which allow fuel puddling (i.e., avoid sink traps). See Sink Traps in Figure B. Fuel trapped in low spots can be expelled when the cap is removed, even if the tank is nearly empty.
    b) Avoid pinches or kinks, as they restrict fuel filling or venting. Hose length may require adjusting depending on second unit body width. See Kinked Fuel Fill System, Figure B
    c) Do not place adjacent hardware such that it may cut or otherwise damage the filler neck and vent hoses and cause fuel or vapor leakage (i.e., avoid unfriendly surfaces) see Hostile Surfaces, Figure B.
    d) Keep the flow of fuel continuously downward from the inlet of the fuel filler pipe all the way to the tank.
    e) The filler hose and vent hose must be clear of moving suspension components so as to prevent abrasion which can result in fuel leakage. They should maintain a minimum of 1 inch clearance to body and surrounding chassis components, except where the hoses and protective sleeve material pass through the designed frame opening.
    f) Be certain that all clamps are secure and properly located.
    g) The fuel filler and filler vent hoses should not contain fittings or connections other than those incorporated in the original design, nor should they be interconnected with each other in anyway.
    h) Ford released parts should be used.

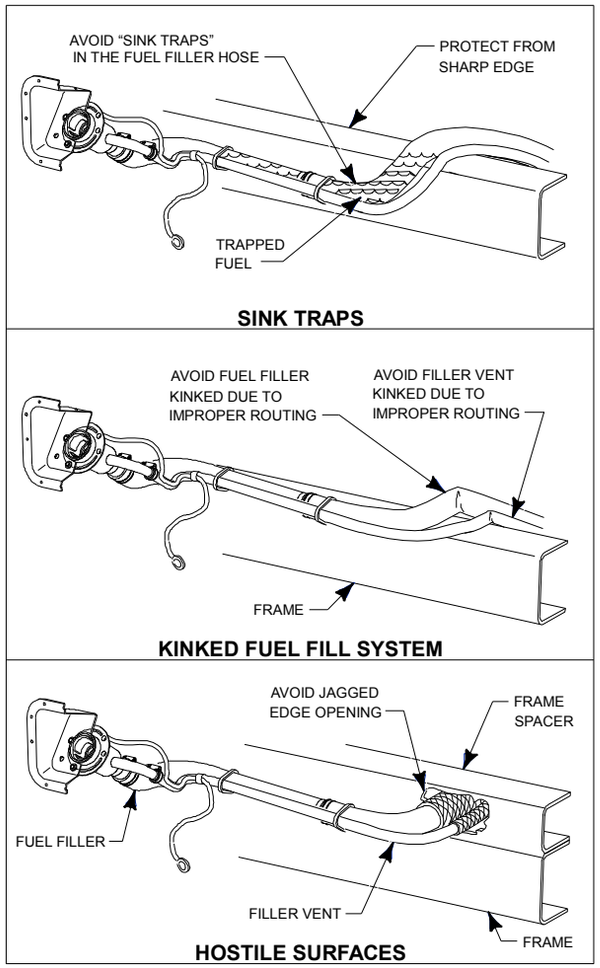

FIGURE B – FUEL FILL SYSTEM INSTALLATION CONDITIONS TO BE AVOIDED

D. FUEL TUBES, HOSES AND PUMPS

1. Do not reroute or change the attachment of fuel lines or fuel vapor hoses. Doing so may alter the vehicle's ability to comply with F/CMVSS 301, Fuel System Integrity, and may adversely affect vehicle performance by increasing the amount of heat absorbed by the fuel system or by restricting its venting.
2. Tubes and hoses should be routed away from and not attached to members that will move or deform during crash situations.
3. Tubes and hoses must be sufficiently flexible to avoid rupture or disconnection resulting from movement of the engine relative to the frame during crash situations.
4. Tubes and hoses should be routed away from hot regions and sharp objects and should be retained adequately to prevent movement into such regions or against such objects.
5. Do not add fuel or vapor line flow restrictors as they can cause engine fuel starvation or abnormally high fuel tank pressures.
6. Do not install auxiliary fuel pumps. This could cause the engine to run rich, producing additional exhaust heat.
7. The special removal tool shown in Figure D on the next page must be used to open push connectors installed on flexible fuel lines if the lines need to be disconnected. The appropriate tool is available from Ford Customer Service Division.
8. The push connectors on flexible fuel lines, if disconnected, must be reconnected by snapping them back into position and installing the appropriate retainer as shown in Figure D on the next page.
9. Avoid pinching or kinking of any fuel vapor hose. (See Figure C below).

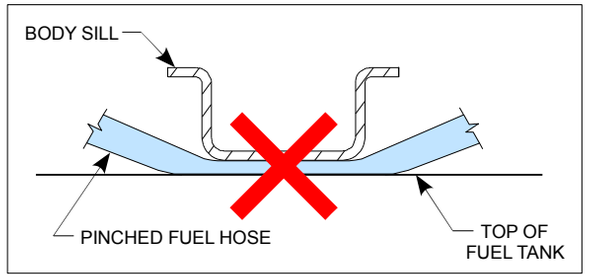

FIGURE C - PINCHED FUEL VAPOR LINES

10. Each of the fuel lines and fuel vapor hose retention clips provided by Ford must be used in original factory locations to prevent misplacement or movement of the lines.
11. Be certain that the vent valves on top of the fuel tanks are seated and secure; do not dislodge or damage them when mounting the second unit body. If they are unseated, fuel leakage may occur. If damaged, the vapor vent system may not function, resulting in increased fuel tank pressure.
12. If a fuel sender is removed for any reason, use a new gasket when it is reinstalled so as to prevent fuel leaks. Be certain the fuel sender is seated and secure on the top of each fuel tank. Do not step upon or place weight upon the sender during vehicle manufacture.
13. Fuel filters installed in the fuel supply line must be of sufficient size to be nonrestrictive to fuel flow and placed so as to be protected from exposure to exhaust heat and physical damage. Ford replacement fuel filters are recommended. Filters are not to be installed in the fuel return line.
14. Temporary shipping fuel lines are not to be reused. They should be disposed of in an appropriate manner.
15. Fuel system components which are disconnected during manufacturing should be capped or plugged promptly to prevent possible contamination.
16. When welding near fuel system components, all metallic components must be adequately shielded and protected from heat or weld splatter. All nonmetallic components must be removed.

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E. FUEL SYSTEM ACCESS FOR AUXILIARY FUEL POWERED EQUIPMENT

Precautions similar to those described in this Fuel System section should be taken in the design and positioning of a fuel system for auxiliary fuel-powered equipment. The auxiliary fuel-powered equipment should be securely mounted so as to withstand forces during crash situations.

E-Series Super Duty Cutaway, E-Series Super Duty Stripped Chassis and Super Duty F-Series, aft-of-axle fuel tanks are equipped with an auxiliary fuel port in the fuel sender unit. The purpose is to provide a fuel supply for fuel powered accessories such as generator sets.

Transit and Super Duty F-Series vehicles have an auxiliary fuel port located on the midship fuel tank sender unit.

Final stage manufacturers that utilize the auxiliary fuel port must install a check valve because of Onboard Fuel System Diagnostics (OBDII). The system may affect the vehicle's compliance with applicable Federal/State emissions laws. Additional information is available in SVE Bulletin Q-42, "Auxiliary Fuel Port Requires Electric Solenoid"; to obtain a copy, log on to https://fordbbas.com and select from the list under the "Bulletins" tab.

All auxiliary fuel ports have a safety cap which must remain in place until a fuel consuming accessory is installed.

An E-Series push connector fuel tank kit 9C24-9B210-AA, included in dunnage or available from your local Ford dealer, will attach to the auxiliary fuel port and accept a 1/4" hose. The kit includes a 90 degree connector and a screw clamp.

For auxiliary fuel port connector information on Super Duty F-Series Chassis Cab vehicles with an aft of axle fuel tank, refer to SVE Bulletin Q-196, "2011 and Later MY Super Duty Auxiliary Fuel Port Connector Service Kits" for additional information.

Transit auxiliary fuel port information is available in the *Ford Transit Body and Equipment Mounting Manual (BEMM)*, Chapter 3.6 Fuel System, available online at https://fordbbas.com under the "Publications" tab. Additional information is available in SVE Bulletin Q-228, "Transit Aux Fuel Port Kits".

Transit vehicles with a gasoline engine have a capped auxiliary fuel tank port; a 90 degree connector can be ordered as a service item, part number CK41-9B210-A*. The auxiliary fuel line is not offered as a service item.

Transit vehicles with a diesel engine have a capped auxiliary fuel tank port; a 90 degree connector can be ordered as a service item, part number CK41-9B210-C*. The auxiliary fuel line is not offered as a service item.

SVE Bulletins are available online at https://fordbbas.com under the "Bulletins" tab.

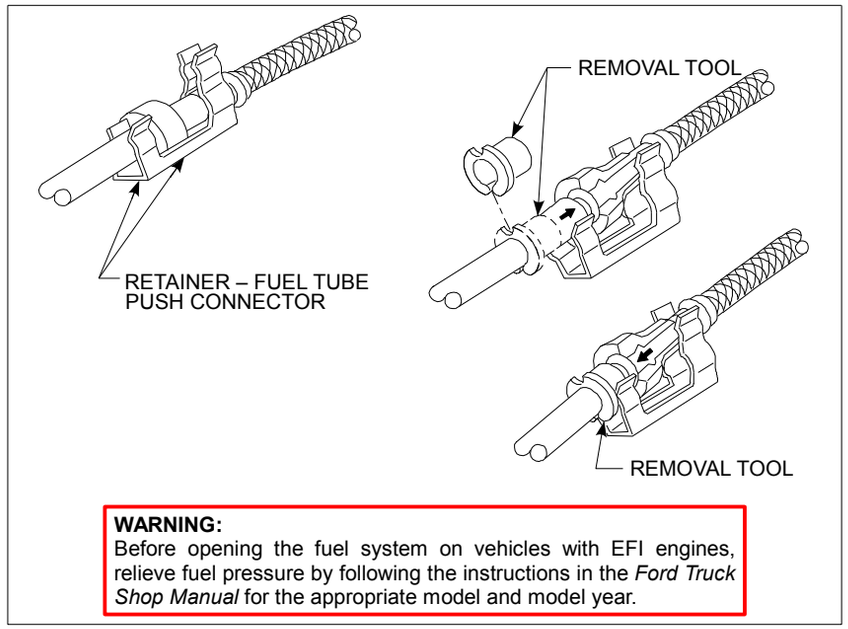

REMOVAL TOOL
RETAINER – FUEL TUBE PUSH CONNECTOR
REMOVAL TOOL
WARNING:
Before opening the fuel system on vehicles with EFI engines, relieve fuel pressure by following the instructions in the *Ford Truck Shop Manual* for the appropriate model and model year.

FIGURE D – FLEXIBLE FUEL LINE PUSH-CONNECT

ELECTRICAL SYSTEM

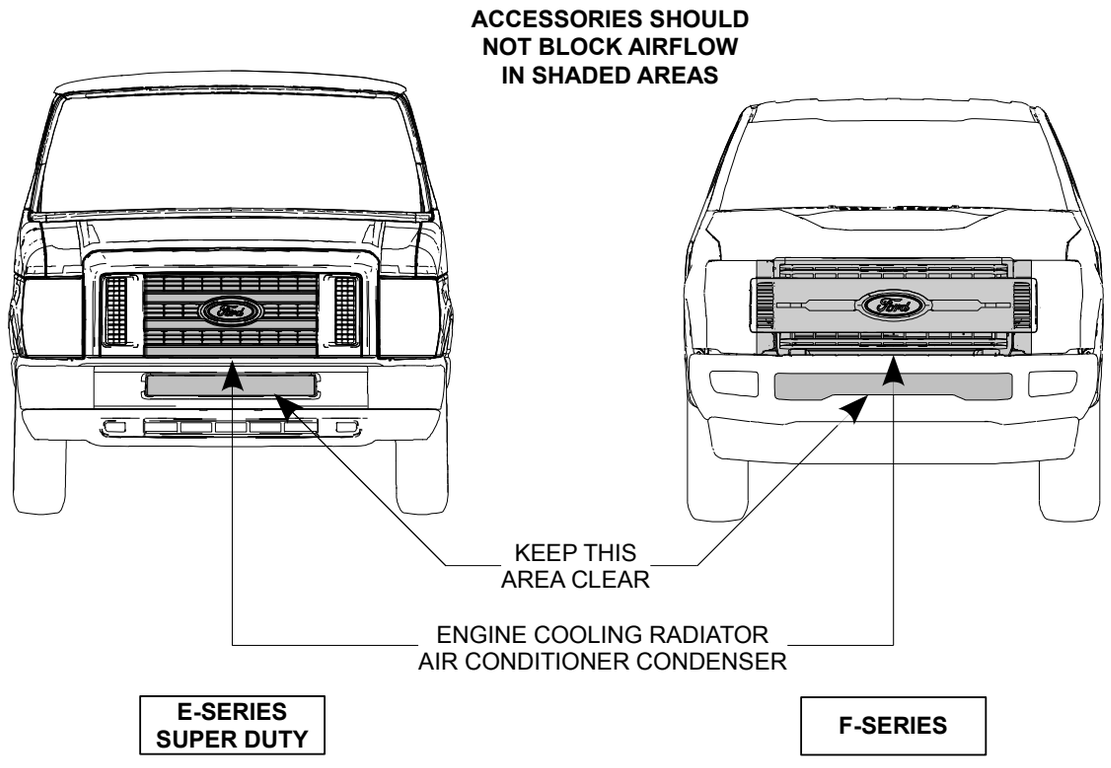
Refer to SVE Bulletin Q-130, "General Electrical Practices", available at https://fordbbas.com under the "Bulletins" tab.

Remaining Fuel Volume (Gallons) at Auxiliary Tube Shut-off Level									
Model	Fuel Tank Capacity								
	25 Gal	26.5 Gal	35 Gal	40 Gal	50 Gal	55 Gal	60 Gal	65 Gal	80 Gal
E-Series	--	--	6.2	5.8	--	8	--	--	--
SD F-Series (Gasoline)	--	3.4	--	5	--	--	--	--	--
SD F-Series (Diesel)	--	3.4	--	5	--	--	--	--	--
F-53	--	--	--	--	--	--	--	--	11.7
F-59	--	--	--	5.2	--	--	--	--	--
Transit (Gasoline)	5	--	--	--	--	--	--	--	--
Transit (Diesel)	7.5	--	--	--	--	--	--	--	--
F-650/750 (Gasoline)	--	--	--	--	8	--	10	--	--
F-650/750 (Diesel)	--	--	--	--	9	8.5	--	11.5	--

DESIGN RECOMMENDATIONS
COOLING SYSTEM / CLIMATE CONTROL SYSTEM

COOLING SYSTEM

1. Ford trucks use “OAT” Motorcraft® Orange Prediluted Antifreeze/Coolant VC-3DIL-B (US), CVC-3DIL-B (Canada). Maintain a 50/50 mixture (determined using recommended Rotunda tool P/N ROB75240 fractometer) of antifreeze-to-water ratio when adding or modifying the heater system or auxiliary heater system. A 60/40 antifreeze-to-water ratio may be necessary during winter months in very cold climates, however, for the remainder of the year a 50/50 ratio should be maintained. For additional information, see SVE Bulletin Q-247, “2017 MY E-Series Coolant Change from G05 to OAT”, available online at https://fordbbas.com under the “Bulletins” tab and the vehicle *Owner's Manual*.
2. Equipment such as flashing lights and sirens, spare tires or any other accessories should not be installed in the grille area forward of the radiator or air cleaner air inlet. Doing so restricts proper airflow through the radiator and engine compartments. E-Series and Super Duty F-Series are illustrated in the figure below.
3. For proper engine cooling, do not alter, change the locations of, or remove the original equipment fan, fan clutch, or shroud.
4. Upper radiator hoses and heater hoses, which are added or replaces, should be EPDM-Kevlar composition. Lower radiator hoses should be EPDM-Rayon composition.
5. The radiator and fan shroud should not be used as structural members and additional components should not be attached.
6. Revisions to the Front End Accessory Drive System may affect the cooling system/component performance and are not recommended.
7. Do not alter or modify the automatic transmission cooling system.
8. The minimum radiator grille opening (excluding all grille parts) for the E-Series Stripped Chassis, to provide optimum cooling for the engine, is 300 sq.in.
9. Equipment, hazardous materials markers, or placards must not obstruct the airflow to the radiator or the air cleaner inlet on the E-Series Super Duty Stripped Chassis.
10. The E-Series Super Duty Stripped Chassis engine compartment must be designed to eliminate any air circulation restriction that would affect the air induction or cooling systems. An engine compartment must provide adequate flow-through ventilation to prevent local air temperature from exceeding recommended maximums.



CLIMATE CONTROL SYSTEM

1. An Auxiliary Heater A/C Connector Prep Package can be either standard or optional on E-Series vehicles for connecting auxiliary climate control systems to the Ford system. The following items are important for the maximum efficiency of the combined systems:
   - The connector tubes are under the floor directly below the driver’s seat.
   - The heater supply tube is identified with a white paint dot and should be connected to the lowest connection port on the auxiliary heater core.
   - The A/C connector tubes have a 20 x 1.5-6g metric thread for high pressure and 24 x 2.0-6g metric thread for low pressure.
   - If the vehicle is equipped with the auxiliary heater-air conditioner, do not operate the front A/C system prior to the addition of an auxiliary system. The system oil could settle in the connector tubes and not provide lubrication to the compressor. See SVE Bulletin Q-47, “A/C-Heater Prep Package (57L) or A/C Prep Package with Rear A/C Controls (57X)”, available online at https://fordbbas.com under the “Bulletins” tab.
   - The Ford auxiliary blower switch requires an electric relay for high-speed blower operation; a relay is included in Ford factory-installed rear climate control systems.
2. R134-a charge A/C systems must use PAG-type lubricating oil Motorcraft part number YN-12-D, Ford part number F2AZ-19577-AD and must meet Ford specification WSH-M1C231-B. Always use the same refrigerant and lubricating oil as originally equipped by Ford.
3. Maintain a 4% suspended oil ratio in the A/C system for proper compressor lubrication.
4. E-Series A/C and refrigerant oil system are built from the factory in the following configurations:

	VEHICLE CONFIGURATION	R-134a (oz)	R-134a (lb)	PAG Oil (oz)
GASOLINE	Front Only	30	1.875	8
	Front w/ Optional Prep Packages	30	1.875	16

A label stating the total refrigerant charge, type of refrigerant (R-134a) and type of compressor lubricant oil (PAG) used must be affixed in a conspicuous place in the engine compartment.

5. Starting in 2016 MY, the F53/F59 basic stripped chassis vehicles incorporated a new design A/C suction line GU9Z-19E636-A* that must be ordered from Ford Component Sales in order to properly complete the A/C system. Ordering information is provided in SVE Bulletin Q-233, “2016 F53/F59 A/C Line Change”, available online at https://fordbbas.com under the “Bulletins” tab.
6. Effective 2017 MY, the A/C compressor PAG oil is provided at the proper level and NO additional oil should be added to the compressor. Compressor oil requirements are addressed in SVE Bulletin Q-234, “F53/59 A/C Compressor Oil Requirement”, available online at https://fordbbas.com under the “Bulletins” tab.

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DESIGN RECOMMENDATIONS
COOLING SYSTEM / CLIMATE CONTROL SYSTEM (Cont'd)

CLIMATE CONTROL SYSTEM (Cont'd)

6. The A/C compressor will cycle during the defrost mode. A refrigerant shut-off valve for the auxiliary system may impair compressor lubrication.
7. R-134A charged A/C systems should use barrier type A/C hose. Barbed fittings and external clamping may not be compatible with this type of hose. Swaged, permanent fittings on this type of hose are recommended.
8. **NEVER ATTACH ANY COMPONENT TO THE TRANSMISSION FILLER AND DIPSTICK TUBE.**
9. Auxiliary heater and air conditioning systems hose routings must consider the following:
   - Dynamic engine roll or any system component which has an operating zone. Make sure there is adequate clearance (e.g., transmission downshift linkage, steering column shift linkage).
   - Do not route heater or A/C hoses directly over or near the exhaust system.
   - Do not route hoses by attaching to the engine.
   - Use only metallic "Y" and "T" type fittings or OEM approved materials.
   - Do not route hose in wheelhouse area.
   - Do not route by sharp edges or moving component parts. There must be shield protection from any potential abrasive source.
   - When routing in stone kickup area, lines should be protected by shields. Minimize use of concentric protective heater hose shields. Limit length of concentric hose shields to 305 mm [12in] maximum.
   - Where possible, encase added suction lines in insulating foam from connector location underbody to the secondary evaporator.
10. For additional information, refer to SVE Bulletin Q-148, "Air Conditioning and Front End Accessory Drive (FEAD) Design Best Practices - E-Series and F-Series", available online at https://fordbbas.com under the "Bulletins" tab.
11. Front End Air Flow:
    - There should be nothing mounted in front of or behind the front end grille opening which could reduce the effective air flow to the cooling module.
    - Under no circumstances should there by any modifications to the fan shroud or stator.
    - Do not modify or remove any seals which are part of the cooling module (i.e., body seals, condenser seal, radiator seals, snow shield). These shields are intended to prevent engine heat recirculation back through the A/C condenser.
12. E-Series Cutaway vehicles ordered with the optional AUX A/C packages:
    - When attaching an aftermarket AUX A/C unit to an existing OEM front A/C system, the AUX A/C unit must use a Thermal Expansion Valve (TXV). A Clutch Cycling Orifice Tube (CCOT) cannot be used.
13. Compressor discharge gas temperature should never exceed 130°C [266°F] under any driving or idle conditions.
14. Do not alter or change the pulley size.
15. If designing an independent refrigerant loop (second compressor, condenser, etc.) for an auxiliary A/C system on a chassis cab vehicle, **DO NOT** order either of the E-Series Auxiliary Heater/ A/C Connector prep packages.
16. If adding auxiliary A/C to an F-Series Chassis Cab system, no prep packages are available. Tap into the system using custom lines that obtain the liquid between the receiver drier and front TXV, and return the suction line between the front TXV and the compressor. The secondary evaporator must use a TXV.

    For additional information, refer to the SVE Bulletin Q-255, "2017 F-Series Super Duty with Aftermarket Auxiliary A/C System Control", available online at https://fordbbas.com under the "Bulletins" tab.

E-SERIES OPTIONAL A/C PREP PACKAGES

1. The A/C Prep Package (available on Stripped Chassis only) consists of a compressor and condenser only with computer logic inside the Powertrain Control Module to interface with the compressor. In addition, a dedicated pressure transducer, included in dunnage, replaces the traditional A/C high pressure switch; for additional information, see SVE Bulletin Q-230, "E-Series A/C Pressure Transducer Change", available online at https://fordbbas.com under the "Bulletins" tab.
2. The Auxiliary Heater/ A/C Connector Prep Package, and Auxiliary Heater/ A/C Connector Prep Package with Rear Controls (E-350/450 Cutaway only) consists of an AUX blower control switch, compressor, condenser, front CCOT HVAC assembly, accumulator, and connection points for a TXV controlled AUX A/C unit.
3. Information on determining air conditioning refrigerant and lubricant quantities are outlined in the Ford Truck Quality Program Guidelines on the web site https://fordbbas.com.

DESIGN RECOMMENDATIONS
EXHAUST SYSTEM / FORD BODY COMPONENTS

EXHAUST SYSTEM

WARNING:
VEHICLE OPERATING TEMPERATURES:
Some trucks manufactured by Ford Motor Company may exhibit high engine compartment and exhaust system temperatures in certain operating modes. Components, including exhaust heat shielding systems, have been installed as standard equipment on some vehicles in an effort to provide thermal protection against such temperatures. Aftermarket equipment installers or intermediate and final stage manufacturers are responsible for providing thermal protection (e.g., underbody heat shields) for any structure or equipment added to the vehicle and should not remove any components or exhaust heat shielding installed on the vehicle by Ford Motor Company.

1. Do not substitute exhaust system components or add to those furnished by Ford, except as noted in this section. Such a substitution or addition may adversely affect engine performance or emissions system effectiveness.
2. Do not change the position or routing of the exhaust system components. Such a change may affect the amount of heat transferred to body, chassis, or powertrain components, particularly fuel system components. Specifically, do not add dual exhausts or reroute exhaust components to the left side of the vehicle.
3. Do not remove or modify existing heat shields. Ford underbody heat shields are installed on vehicles to provide heat protection for the vehicle floor and body mounting system, and must remain in place on the completed vehicle.
4. Exhaust heat shields should be added by a body builder and should extend far enough beyond the exhaust system components to protect underbody surfaces from heat radiated at any angle. Add shields over the muffler and exhaust pipe kick-up areas.
5. Do not remove Ford furnished exhaust clamps and hangers.
6. An additional exhaust hanger should be installed, if appropriate, to support extended tailpipe length necessitated by body dimensions.
7. Do not make a rigid connection between the exhaust system and the body.
8. Do not apply body undercoating on the fuel tank, fuel fill hose, or fuel fill vent hoses. The extra insulation on these components may cause excessive heat build-up or possible material incompatibility concerns (See Figure E).
9. Do not apply body undercoating within twelve inches of the area directly above the exhaust, on any components within twelve inches of the exhaust, or to any part of any exhaust system. Undercoating will smoke or burn if subjected to high heat (See Figure E).

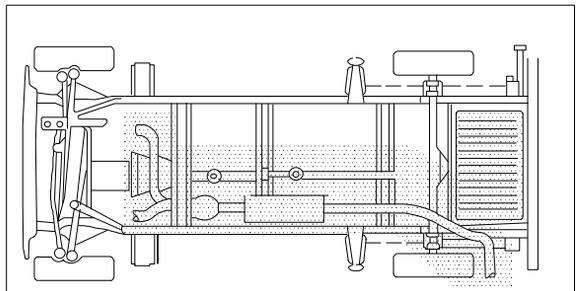


FIGURE E - DO NOT APPLY UNDERCOATING IN SHADED AREA

10. Extensions to the exhaust outlet pipe should direct exhaust away from the body to minimize the possibility of fumes entering the vehicle. Extensions should also protrude beyond the vertical body surface. Transit Chassis Cab and Cutaway vehicles include an exhaust extension in dunnage; for further information, reference the *Transit Body Equipment Mounting Manual (BEMM)* available online at https://fordbbas.com under the “Publications” tab.
11. Install all underbody plumbing for heaters, air conditioners, and other accessories so that they are not installed against sharp surfaces or jagged edges. Protect from exhaust heat when routing.
12. Use only stainless steel for any exhaust system modifications or additions.
13. Exhaust system revisions should consider thermal expansion of materials and the effect on design clearances.
14. For additional Super Duty F-Series diesel engine information, reference SVE Bulletin Q-253, “2017 MY F-Series Super Duty 6.7L Exhaust System Modifications”, available at https://fordbbas.com under the “Bulletins” tab.

FORD BODY COMPONENTS

1. Modifications to doors, roof, or body side panels may have an effect on F/CMVSS 206, 208, 210, 212, 214, 216a, 219, 226, and 301 compliance. Refer to the Statements of Conformity section in the *Incomplete Vehicle Manual* for compliance representations.
2. Running boards or entry steps should use a mounting system that will attach only to the body. The Ford body to frame isolators allow body movement which may loosen fasteners. A combined frame and body mounting system may cause frame induced noise, vibration, and harshness (NVH) to transfer through such a mounting system into the body.
3. Use a butyl type sealer on trimmed body sheet metal panels to prevent corrosion.
4. Temporary mounting pads may eliminate chipping and scratches when accessories are installed.
5. Select materials which will not have a corrosive action with each other.
6. Additional fresh air vents should be located so that engine exhaust cannot be drawn into the vehicle.
7. When adding holes to the floor of the vehicle, consideration must be given to all components below the floor. The use of drill stops is recommended.
8. Fasteners added to the floor should not point at the fuel tank or the fasteners should have an appropriate shield. Components with sharp edges should have an appropriate shield to eliminate the possibility of fuel tank penetration in crash situations.
9. Components added to the E-Series engine cover should allow for easy removal. Refer to the Statements of Conformity in the *Incomplete Vehicle Manual* or the Occupant Protection Zone requirements for the engine cover and other affected areas in the Safety / Emissions section.
10. The E-Series engine cover seal requires that carpeting and insulation should be installed as shown in Figure F.
11. Power operated windows, a partition, or roof panel systems, when added to a vehicle with a GVWR of 4536 kg [10,000 lb] or less, must comply with the requirements of F/CMVSS 118; refer to the Statements of Conformity in the *Incomplete Vehicle Manual*.
12. When a Second Unit Body (SUB) or rear closure panel is attached directly to the Cutaway body, difficulty may be experienced when closing doors due to air pressure build up. It is recommended that vent(s) be installed to allow “ONE WAY” pressure release from the inside of the cab to the outside. The recommended minimum size of the venting is 36 square inches.

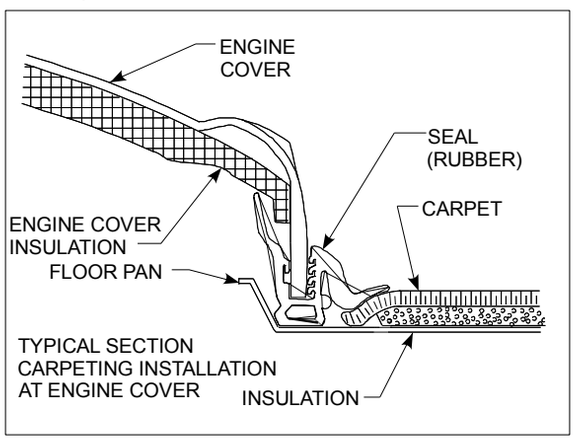


FIGURE F - E-SERIES ENGINE COVER SEAL

DESIGN RECOMMENDATIONS
WHEELS & TIRES / TPMS

WHEELS AND TIRES

WARNING:
Some aftermarket wheel assemblies may not be compatible with some vehicles and should not be used. Use of incompatible wheel assemblies may result in wheel fractures, separation, with the potential for an accident, and injury to occupants. Ford recommends that only wheel assemblies approved and released by Ford Motor Company for the vehicle model should be used.

WARNING:
Re-torque all lug nuts to specification. It is imperative that the dealer re-torque all wheel lug nuts on all vehicles prior to delivery to the final vehicle purchaser. Dual rear wheel vehicles may be shipped with the outer rear wheels removed and, therefore, the dealer must ensure that the lug nuts are re-torqued to the proper specification before the vehicle is delivered to the final vehicle purchaser. Improperly tightened lug nuts could loosen and allow the wheel to come off while the vehicle is in motion, causing loss of control.

1. Use only wheels with the same load capacity, rim width, rim offset, and mounting configuration as those originally installed on the vehicle. Consult an authorized Ford dealer for correct wheel load capacity, size, and usage. Wheels used must conform to the F/CMVSS 120. The use of any wheel or tire, other than those originally installed on the vehicle as manufactured by Ford, may adversely affect load carrying capacity, handling, bearing life, ride, braking performance, speedometer/odometer accuracy, automatic transmission shift timing, Tire Pressure Monitoring System (TPMS) operation and tire/wheel clearance of the body and chassis.
2. Use only replacement tires that are the same size, load index, speed rating and type (such as P-metric versus LT-metric or all season versus all-terrain) as those originally provided by Ford. The recommended tire and wheel size may be found on either the Safety Compliance Certification Label or the Tire Label which is located on the B-pillar or edge of the driver's door. If this information is not found on these labels, consult a Ford dealer. Use of any tire or wheel not recommended by Ford can affect the safety and performance of the vehicle, which could result in an increased risk of loss of vehicle control, vehicle rollover, personal injury and death. Additionally, the use of non-recommended tires and wheels could cause steering, suspension, axle or transfer case/power transfer unit failure. If you have questions regarding tire replacement, contact an authorized Ford dealer. Tires used must conform to FMVSS 119 (New Pneumatic Tires for Motor Vehicles) and FMVSS 139 (New Pneumatic Radial Tires for Light Vehicles) in the United States, or to the Motor Vehicle Tire Safety Regulations in Canada.
3. SRW vehicles with a GVWR of 4536 kg [10,000 lb] or less must comply with FMVSS 138 (Tire Pressure Monitoring Systems). Reference the Tire Pressure Monitoring System (TPMS) section in *Owner Guide*, *Ford Shop Manual* & FMVSS 139 (New Pneumatic Tires for Light Vehicles).
4. If you loosen or remove wheel lug nuts for any reason, or have in your possession a vehicle at any of the mileage intervals listed in the Typical Wheel Lug Nut Torque Specifications table below, check the lug nut torque and **re-torque to the specifications as listed in the applicable *Owner Guide* recommended maintenance procedure** (Note: table shows typical values).

TYPICAL WHEEL LUG NUT TORQUE SPECIFICATIONS

	RE-TORQUE MILEAGE		WHEEL LUG NUT TORQUE	
VEHICLE TYPE	**Km**	**Miles**	**Nm**	**Ft Lb**
E-Series				
E-350 SRW	160	100	203	150
E-350/450 DRW	160	100	190	140
	800	500		
F-Series				
Super Duty F-250/350 SRW	160	100	224	165
Super Duty F-350/450/550 DRW	160	100	224	165
	800	500		
Transit				
Transit-150/250/350 SRW	160	100	200	148
Transit-350 HD DRW	160	100	200	148
	800	500		

BRAKE COMPONENTS:

WARNING: Brake line damage or corrosion
Do not wrap brake lines with any material that could cause water, dirt, sand or other foreign material to accumulate around the lines, which could potentially result in brake line damage or corrosion.

TIRE PRESSURE MONITORING SYSTEM (TPMS)

Single Rear Wheel (SRW) vehicles with a GVWR of 10,000 lbs (4356 kg) or less, as manufactured by Ford Motor Company, comply with FMVSS 138 Tire Pressure Monitoring System. Operational and wheel replacement information is provided in the vehicle's Owner Guide and Ford Shop Manual.

NOTE: The Tire Pressure Monitoring System is subject to interference from the addition of metallic structures between the wheel-mounted sensor transmitters and the on-board receiver. Additionally, TPMS is subject to interference from any added equipment or device that emits radio frequency (RF) energy.

The vehicle, when completed, will conform to Standard 138, Tire Pressure Monitoring Systems, if:

- No alterations are made to the tire pressure sensors (valve stems), wheels, tires, recommended tire pressures, electrical Smart Power Distribution Junction Box, instrument cluster, instrument panel wiring, or software calibrations
- Wheel bases are not lengthened beyond 176 inches
- After vehicle upfit, function of the Tire Pressure Monitoring System is verified in accordance with FMVSS 138

DESIGN RECOMMENDATIONS
SUSPENSION & STEERING / ENGINE

SUSPENSION AND STEERING SYSTEM – VEHICLE HANDLING INFORMATION

The weight of the body structure and its center of gravity location (both longitudinally and vertically), as well as the weight and positioning of the cargo load, are important to the handling of the completed vehicle. Subsequent stage manufacturers should note that matching a body to a chassis in a manner appropriate for the intended use of the vehicle is the responsibility of the final stage manufacturer. Following the representations in this book or the Incomplete Vehicle Manual, with respect to center of gravity locations and body weights for compliance with Federal or Canadian Motor Vehicle Safety Standards, is only part of the task of producing a completed vehicle that handles appropriately in service.

1. Front end alignment warranty policy for incomplete vehicles is based upon the completed vehicle remaining within OEM weight ratings, vehicle attitude, suspension and wheel/tire guidelines, and other characteristics affecting wheel alignment. Exceeding or modifying these restrictions may jeopardize related warranty.

IMPORTANT: The final-stage manufacturer is responsible for verifying that the front wheel toe is within Ford specifications on completed vehicles. The steering wheel clear vision (horizontal or level orientation of the steering wheel) should also be maintained when resetting wheel toe. These specifications are found in the General Suspension section of the *Ford Shop Manual*.

2. Modifications made by subsequent stage manufacturers, particularly those that significantly affect vehicle ride heights or off-loading of vehicle weight from front of chassis (frame stretch, addition of a lift gate, etc.) may cause vehicle control problems during excessively sharp turns or other abrupt steering maneuvers, possibly leading to rollover or other accidents that could result in death or serious injury.

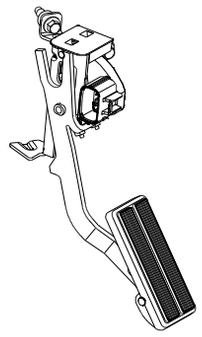
IMPORTANT:
The steering gear, intermediate shaft, coupling shaft, linkage, column, and steering wheel should not be altered nor relocated. Steering linkage travel should not be restricted.

3. Ford Motor Company front and rear GAWRs and GVWR must not be exceeded.
4. Front or rear suspension components should not be drilled, cut, welded, or relocated for any reason.
5. Welding to the frame in the steering gear area is not recommended.
6. If rear suspension spacers are used between the spring and axle seats to accommodate side-to-side variations, they should not exceed 3/8 inch. The spacers should not exceed the profile of the axle spring seat. Additional spacing may adversely affect driveline angles and axle system package clearance. Also affected are spring stress limits from excessive jounce travel.
7. Do not use any suspension component as a welding ground.
8. When welding or cutting near suspension components, shield and protect all springs and rubber components from heat penetration and welding splatter.
9. Any add-on device mounted on the steering column, shroud, multifunction switch, or gear selector lever, must not affect steering column angles, tilt mechanism (if so equipped), range of operation, or steering column mounting hardware. Any such device must not interfere with steering column collapse stroke travel during crash situations or air bag deployment.
10. Vehicles equipped with an air suspension system must verify that the settings are correct once the vehicle is completed by the final stage manufacturer. Refer to the applicable Ford truck workshop service manual for the complete procedure.

NOTE:
Ford Motor Company provides Type I and Type II FMVSS/CMVSS 105 compliance statements for vehicles built to factory standard or optional specifications. Suspenion ride height and/or spring rate modifications are factors that may affect compliance to this Standard. If an alterer or final stage manufacturer modifies the suspension ride height or spring rate of the factory-equipped vehicle, then they are responsible for engineering analysis or physical testing to ensure compliance and sign-off to Standard 105.

ENGINE

1. Refer to Emission Control Modifications in the Safety/Emission section of this book prior to making modifications to any engine component that could affect the emission certification.
2. The engine should not be operated with the hood up or removed. This may allow excessive unforced air to circulate, potentially having an adverse effect on the cooling system.
3. Do not use manual throttle kickers.
4. When using electric throttle kickers on gasoline engines, set the high idle RPM at as low as possible to obtain the required performance. The idle speed must be set when the engine is at normal operating temperature and under normal load. This RPM setting should be affixed to the vehicle and should be checked after the 2,000 mile brake-in engine tune up. This information should be provided to the purchasers. The addition of throttle kickers may affect electronic transmission operation.
5. An auxiliary crankshaft bearing support is required on all modular gas engines before a FEAD-mounted PTO can be installed. Refer to the Power Take-Off section of this book.
6. Do not tap into the electrical circuits attached to the Accelerator Pedal Position Sensor (APP) on the accelerator control. Do not bypass the electrical circuits attached to the APP. See figure below for a typical accelerator control.



7. Installation of a gasoline engine speed governor is permissible, provided the governor design is compatible with each respective throttle body for the individual engine application and it does not exceed the specified engine maximum RPM. It must also meet all noise and engine emission requirements. Governor installations may affect electronically controlled transmissions. Contact the Ford Truck Body Builders Advisory Service before installing.

   Ford Motor Company also offers OEM production options for speed limiting on multiple vehicle lines. See vehicle *Order Guides* for additional information.

DESIGN RECOMMENDATIONS
DRIVELINE / TRANSMISSION / FRAME / JACK

DRIVELINE

1. SVE Bulletin Q-14, “Guidelines for Modifying Truck Drivelines”, is available at https://fordbbas.com from the list under the “Bulletins” tab. Any deviation from Ford Motor Company specifications may adversely affect powertrain system operation including engine and transmission, or component reliability. Subsequent stage manufacturers or installers are responsible to maintain Ford specifications in the completion of such modifications.
2. Rear axle vent and hose, if installed, must not be bent, pinched, or obstructed so that normal “breathing” of the rear axle is provided.
3. On all rear axle assemblies, additional bracket bars or supports must not be welded to the axle assembly. Attachment of any equalizing-type trailer hitch or auxiliary suspension systems (springs) must not be attached to the rear axle assembly.

TRANSMISSION

1. The transmission oil filler tube and dipstick must not be altered by bending, lengthening, or shortening, and must be readily accessible in the engine compartment for checking lubricant level. **NEVER ATTACH ANY COMPONENT TO THE TRANSMISSION FILLER AND DIPSTICK TUBE.**
2. The installed engine angle must not be altered. The relative position of engine and transmission to shift linkage must not be altered.
3. Transmission vent must not be altered, pinched, or collapsed, and the vent opening must not be restricted or relocated.
4. Adequate tool clearance and suitable access openings for transmission adjustments must be provided. Transmission removal provisions must also be considered.
5. Transmission oil cooler lines should not be kinked, bent, or restricted. All oil cooler lines must be properly retained with adequate clips. The truck-type external oil cooler must not be “boxed in”, which would restrict adequate air circulation. Use only Ford factory coolers. Some automatic transmissions are equipped with “Stand Alone” transmissions fluid coolers. Vehicles equipped with this new oil-to-air cooler (OTA) may not have a transmission fluid cooler in the radiator. The OTA is located in front of the radiator and will require replacement every time the transmission is reworked or replaced. The cooler lines and Cooler Bypass Valve (CBV) must also be cleaned and backflushed.

CAUTION:
Failure to replace the OTA, backflush the cooler lines and cooler bypass valve (CBV) may result in transmission assembly internal damage.

6. Transmission shift cable, transmission outer shift lever, and shift cable bracket must not be altered and must have provisions for adjusting tool clearance. A severe duty shift cable (booted) is available as a service part, from a Ford Dealer, for Super Duty F-Series vehicles which experience extensive off-road use.
7. Some automatic transmissions may be equipped with a transmission cooler bypass system. The purpose of the cooler bypass valve is to allow some transmission fluid to bypass the transmission fluid coolers and return to the transmission sump during cold weather operation. This provides a faster transmission fluid warm up and increased lube flow during cold weather operation. Do not remove nor modify this system or transmission damage may occur. Do not use the cooler bypass line as a fitting point. Vehicles equipped with transmission cooler bypass will NOT have a hot water feed circuit from the water pump to the radiator tank containing the transmission cooler.

CAUTION:
Do not use the cooler bypass valve (CBV) as a handle – damage to the CBV and transmission may result. This also causes leaks.

8. Transmission service identification tags must not be removed nor destroyed. If the transmission is reworked or replaced, the tag should be attached to new transmission.
9. Electronically controlled automatic transmission wire harness routing location, wire harness locating clips, all heat shielding, and clearance to the exhaust must be maintained as installed from the assembly plant.
10. Body structures should not be less than 1.00 inch from the rectangular vent holes on the top surface of the manual transmission housing.
11. SVE Bulletin Q-14 (Drivelines) and SVE Bulletin Q-18 (Wheelbases) contain additional detailed information on modifications which may affect transmissions. SVE Bulletins are available online at https://fordbbas.com under the “Bulletins” tab.

FRAME

WARNING:
Failure to follow the recommendations below may weaken the vehicle frame, which could result in death or serious injury.

1. Holes that would weaken the frame sidemember should not be drilled in the frame. Holes are not to be drilled in the sidemember’s top or bottom flange.
2. Holes to mount brackets, out-riggers, and supports, may be drilled in the vertical frame side rail web with the following restrictions:
   - Material between edge of hole and inside of upper or lower flange must not be less than 1.50 inch for low carbon steel (36,000 PSI yield).
   - The minimum edge distance between any two holes up to 0.625 inch diameter must be 1.00 inch. For larger than 0.625 inch diameter holes, the minimum edge distance must be 1.5 times the diameter of the largest hole.
   - 0.75 inch is maximum hole diameter.
   - Avoid close vertical succession of fasteners.
   - All attaching fasteners, including flat washers, must be of high strength steel (Grade 8).

WARNING:
When welding is performed anywhere on the vehicle, precautionary measures should be taken to prevent damage to electrical system wiring or components.

3. Prior to welding, any parts which could be damaged by excessive temperatures should be removed or adequately shielded. Also, prior to welding, disconnect both batteries, and the PCM. Ensure the welder ground return clamp is positioned as close to the affected welding area as possible (not more than 12 inches). Also, the welder ground return clamp should be on the same sheet metal or frame being welded upon. Computer processors should be removed if welding is to be done within their close proximity. Welding cables should never be allowed to lay on, near, or across any electrical wiring or electronic component during welding. After welding, when parts are cool, carefully inspect wiring and electrical components for shorts or other damage which could draw excessive currents and possibly cause an electrical system short when the battery is reconnected.
4. Do not weld on frame flanges, including the bend radii.
5. When welding low carbon steel side rails (36,000 PSI yield strength), emphasis should be placed upon weld application techniques to avoid stress risers that may adversely affect frame operating stresses. When welding within 4 inches of any crossmember or suspension rivets, remove the rivets and replace with Grade 8 bolts and nuts.
6. Do not modify or alter the convoluted frame sections in the area behind the front bumper. Modifications or alterations could have an adverse effect on vehicle performance in a crash situation.
7. Wheelbase alteration and frame extension guidelines for E-Series Super Duty Cutaway are available in SVE Bulletin Q-18, “Guidelines for Modifying Ford Light Truck Wheelbases”, and for F-650/750 in SVE Bulletin Q-140, “Wheelbasse Modifications - F650/750”. SVE Bulletins are available online at https://fordbbas.com under the “Bulletins” tab.

WARNING:
Stability Control is Specifically Calibrated and Validated only for your Vehicle’s Original Configuration. If you alter your Vehicle’s chassis Components, for example, a wheel base extensions or reductions, tag axle addition or removal, a major body Change such as conversion of a tractor into a truck. Ford Motor Company is not responsible for the performance of the Stability control system if you modify any Major components such as axle, Suspension or steering system.

8. Transit frame extension guidance is referenced in SVE Bulletin Q-225, “Transit Body Equipment Mounting Manual”, with a link to the *Transit Body Equipment Mounting Manual (BEMM)* , available online at https://fordbbas.com under the “Bulletins” tab. Any deviation from the original vehicle specification will become the responsibility of the subsequent stage manufacturer or installer. This may affect transmission operation and durability.
9. Recommend the use of OEM front tow hooks only. See the *Owner's Manual* for towing instructions.
10. To prevent collapse of the frame side rail flanges, when U-bolts are used for the attachment of bodies to the truck chassis, vertical spacer bars must be used between the upper and lower flanges at each U-bolt.
11. All E-Series Super Duty Cutaways or Stripped Chassis with a 176 inch wheelbase and equipped with a 55 gallon fuel tank will require an 18 inch minimum frame extension to provide for an adequate departure angle fuel tank clearance.
12. School bus rear bumpers should meet the following recommended minimum specifications: height 203.2 mm [8.00 in] at 10,050 lbs, and 241.3 mm [9.50 in] over 10,050 lbs; 50.8 mm [2.00 in] upper and lower flange; 304.8 mm [12.00 in] wrap-around; 4.7 mm [0.187 in] thick. See the *Incomplete Vehicle Manual* for additional information.

JACK

If a jack is provided, it must be stowed in a location accessible to the operator.

DESIGN RECOMMENDATIONS
AMBULANCE BUILDER GUIDELINES

NOTE:
A Ford vehicle is suitable for final stage manufacture into an ambulance only if equipped with a Ford Ambulance Preparation Package. Ford urges ambulance manufacturers to follow the recommendations furnished in the *Incomplete Vehicle Manual*, (and any pertinent supplements), and the Qualified Vehicle Modifier (QVM) guidelines. Using a Ford vehicle without the Ford Ambulance Preparation Package to produce an ambulance voids the Ford warranty and could result in elevated underbody temperatures, fuel over-pressurization and the risk of fuel expulsion and fires. Vehicles equipped with Ford Ambulance Preparation Packages have labels located on (the inside) driver door lock pillar that state that the vehicle is so equipped.

INFORMATION

Ford urges careful consideration of the recommendations that follow. They are based on analyses of component and vehicle tests, actual service situations, and engineering judgments. Disregard of these recommendations may affect the durability, reliability, handling and performance characteristics of a completed vehicle and may elevate underbody temperatures and increase the potential for fire, or may affect the safety of the occupants in the event of an accident.

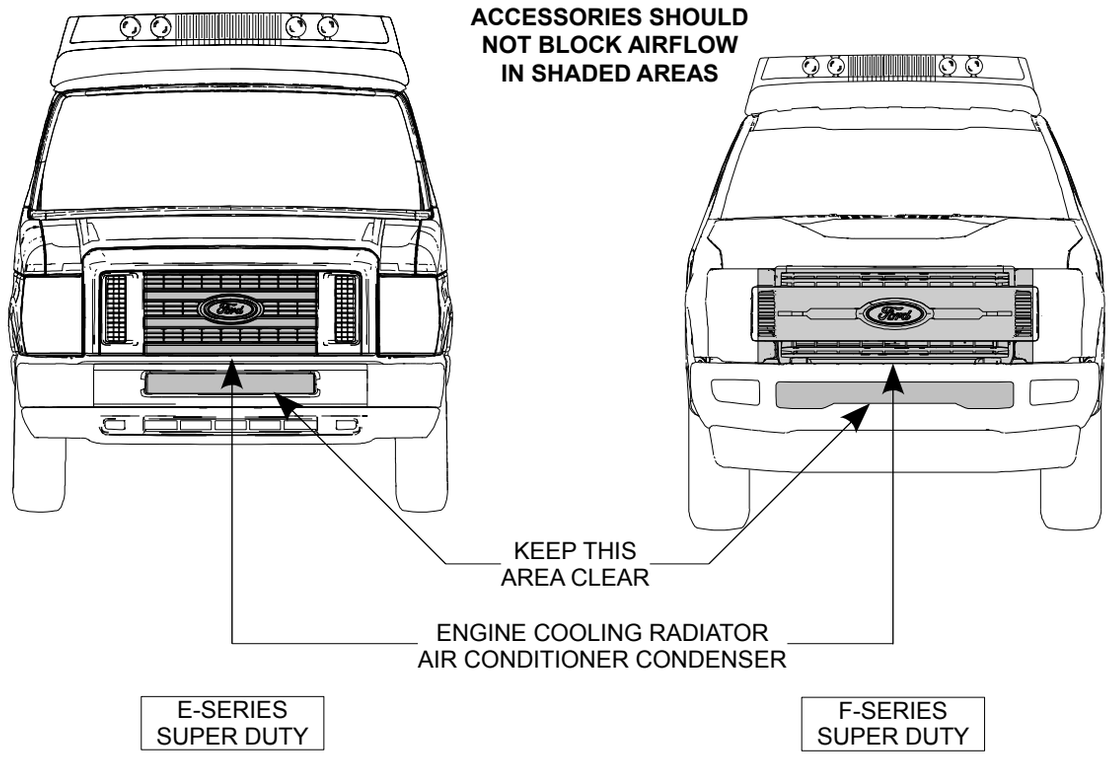
These recommendations are supplemental to U.S. And Canadian Motor Vehicle Safety compliance representations provided in the *Incomplete Vehicle Manual*. Additional information is also provided in this book and the *Ford Truck Shop Manual* which may be helpful to subsequent stage manufacturers. Subsequent stage manufacturers are encouraged to contact the Ford Truck Body Builder Advisory Service if they have any questions concerning these recommendations; contact information is available at online at https://fordbbas.com.

GUIDELINES

1. All Exhaust System and Underbody Heat Management statements in the SECOND UNIT BODY MOUNTING and DESIGN RECOMMENDATIONS sections of this book apply to completed ambulance type vehicles
2. Data concerning the effect of hood louvers is inconclusive. If a body builder chooses to add them, the opening should be directed rearward to avoid recirculating discharged hot air through the radiator.

NOTE:
The vehicle interior vent air enters the passenger compartment at the base of the windshield. Louvers may direct heated air or fumes toward this opening. Removal of the underhood insulation may affect Exterior Noise compliance. See the Exterior Noise information in the *Safety / Emissions* section of this book.

3. To deal with higher electrical loads, Ford vehicles with the Ambulance Preparation Package may be equipped with dual alternators, dual batteries and heavy duty wiring to handle higher electrical loads. Added wiring should be of sufficient capacity to handle the higher current. The alternator should not be modified, altered nor replaced.
4. Added Second Unit Body (SUB) vents, especially powered vents, should be located away from the fuel filler, fuel venting areas and exhaust to avoid fuel fumes and vapors entering the interior of the vehicle.
5. Equipment such as flashing lights and sirens, spare tire, or any other accessories should not be installed in the grille area forward of the radiator or air cleaner air inlet. Doing so restricts proper airflow through the radiator and engine compartment. Lights, speakers, or sirens should not be mounted in the center area of the grille. Equipment should be mounted as far outboard as possible, not to exceed 90 square inches each or 180 square inches combined in area. Electrical equipment, regardless of mounting location, should not be grounded through the hood sheet metal nor hinges due to possible damage to the radio system and wiring.
6. An ambulance is not to be used as a tow vehicle.



DESIGN RECOMMENDATIONS
NEW VEHICLE STORAGE GUIDELINES

GENERAL

- Store vehicles in a dry ventilated place; protect from sunlight if possible.
- If vehicles are stored outside, provide regular maintenance against rust and damage.
- Ensure chassis interior and dunnage box is not exposed to the weather and the potential damage that can occur.
- On cutaways and right-door delete models, ensure back panel plastic sheet is intact and temporary door (right-hand delete option) is in place when vehicles are stored outside or moved.
- Any chassis with an incomplete roof modification should not be stored outside unless appropriately protected.

BODY

- Wash vehicle thoroughly to remove dirt, grease, oil, tar, or mud from exterior surfaces, rear wheel housing, and underside of front fender.
- Periodically wash vehicles stored in exposed locations.
- Touch up exposed raw or primed metal to provide rust protection.
- Cover chrome and stainless steel parts with a thick coat of auto wax to prevent discoloration. Rewax as necessary when the vehicle is washed.
- Lubricate all hoods, door hinges and latches with a light grade oil.

  CAUTION: Keep all rubber parts free from oil and solvents.
- Cover the interior soft trim to prevent fading, if stored in exposed location.
- Body Builders should review their vehicle receiving, storage and production handling procedures to assure the chassis interior and dunnage box are not exposed to the weather and the potential damage that can occur. On cutaway chassis, builders should verify that the back panel plastic sheet is intact and the temporary door (right-hand door delete option) are in place when vehicles are stored outside or moved. Any chassis with an incomplete roof modification should not be stored outside unless appropriately protected.

ENGINE

- Start the engine every 15 days and move the vehicle at least 25 feet. Run it at fast idle until it reaches normal operating temperature.
- Shift the transmission into all gears while engine is running at idle speed.

FUEL SYSTEM

- Regularly move vehicles short distances to mix fuel anti-oxidation agents.

  NOTE: During extended periods, if vehicle is stored for 60 days or more, gasoline may deteriorate due to oxidation. This can damage rubbers and other polymers in the fuel systems such as fuel pressure regulator diaphragms and fuel line connector seals. It may also clog small orifices. Diesel fuel deterioration in the form of fuel separation, sludge formation, and bacterial growth can cause restrictions in fuel supply lines, filters and sticking of fuel-injection system components.

  A commercially available gasoline fuel stabilizer (“Sta-Bil” or equivalent) should be added to gasoline-powered vehicles or a diesel fuel stabilizer (“Fire Prep 100” or equivalent) to diesel-powered vehicles whenever actual or expected storage periods exceed 60 days. The manufacturer’s instructions packaged with product should be followed. The vehicles should then be operated at an idle speed to circulate the additive throughout the fuel system.

  A volatile, corrosion inhibitor (NOx Rust VCI 105" or equivalent) added to the fuel will protect the fuel tank inner surface from corrosion. Follow instructions packaged with product.

COOLING SYSTEM

- Maintain appropriate antifreeze protection against freezing temperatures.
- Only use coolant as recommended in your vehicle owner's manual.

BATTERY

- Check and recharge as necessary.
- Keep connections clean and covered with a light coat of grease.

BRAKES

- Make sure brakes and the parking brake are fully released.

TIRES

- Maintain recommended air pressures.

MISCELLANEOUS

- Verify that all linkages, cables, clevis pins, and levers under the vehicle are covered with grease to prevent rust.
- Move trucks at least 25 feet every 15 days to lubricate working parts and prevent corrosion.

TRANSMISSION

- Run engine to normal operating temperature.
- Shift the transmission into all gears with engine running at idle speed.
- Check fluid level and condition (no water contamination, etc.).
- Stripped Chassis vehicles – cover transmission to prevent water from entering through the vent.